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Greenland Halibut in NAFO Subarea 2 and Divisions 3KLMNO – Short-term and Medium-term Projections from an Extended Survivor Analysis

by

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Abstract

In order to provide some information for short- and medium-term management of the stock of Greenland Halibut in NAFO Subarea 2 and Divisions 3KLMNO, a catch projection associated with a risk analysis were performed on the basis of a *statu quo* fishing level. The input data were taken from an extended survivor analysis. The results show that on the *statu quo* assumption catches are expected to increase until 2002, to stabilise until 2004 and decrease after, the spawning stock biomass indicator is expected to increase until 2005 to decrease after.

Materials and Methods

The input data are from an extended survivor analysis (Pope, 1999; Darby and Mahé, 2000) and are summarized in Table 1.

Numbers in 2000 from age 1 to 14+ from the XSA.

Numbers at age 1 in 2000 and following years assumed to be equal to the 1975-1997 geometric mean from the XSA.

Catch in weights are the average from 1996 to 1999 and are also used as stock weight.

The *statu quo* F vector was derived using the average 1997-1999 PR scaled to the F 99.

Natural mortality was assumed equal to 0.2.

In view of the discrepancies between the estimates of abundance of the year-classes 1994 to 1996 from the XSA and their contribution in the catch-at-age, these were considered to be potentially over estimated and were shrinked to the long-term geometric mean :

$$N = 0.5 \times Nxsa + 0.5 \times GM(75\text{-}97)$$

The catch prediction in year y:

$$C_y = \sum_{a=1}^{14} W_a F_a N_{ay} \left(1 - e^{-Z_a}\right) \Big/ Z_a$$

Numbers in succeeding years for ages 1 to 13:

$$N_{a+1y+1} = N_{ay} e^{-Za}$$

Numbers in succeeding years for age 14 (plus group):

$$N_{14y+1} = \left(N_{13y} + N_{14y}\right) e^{-Z_{13}}$$

The risk analysis was performed through a Monte-Carlo simulation (software @Risk, 5000 iterations). CVs for numbers at age are from the XSA output, CVs for the *statu quo* vector are from the average 1997-1999 exploitation pattern, CVs for the stock (= catch) weights are from the 1996-1999 average. CVs for natural mortality were given an assumed value of 0.15. Except for the numbers at age for which a lognormal error model was used, all the parameters were given an normal error distribution.

Results and Discussion

The deterministic short term catch prediction for 2001 at F *statu quo* is of 44 000 tons. The probability profile (Fig. 1) shows that the 90% confidence interval is (38 000-52 000 tons). There is a less than 10% probability of exceeding F *statu quo* at a level of catch of 39 000 tons.

A ten-year projection was carried assuming a recruitment equal to the long-term geometric mean (1975-1997) and assuming a *statu quo* fishing mortality. The trajectories of catches, 5+ biomass as a proxy for the exploitable biomass and the 10+ biomass as a proxy for the spawning stock biomass are given in Fig. 2a-c. Under this scenario, catches and exploitable biomass are expected to increase until 2002, remain stable at around 55 000 tons until 2004 to decrease after. The 10+ biomass is expected to increase until 2005 to decrease after. This scenario is driven by the strong recruitment from the mid-1990s year-classes. Most important to take into consideration is that unless some good recruitment occurs in the future, the increase in catch level is temporary. The present exploitation pattern should allow an increase in the older population biomass. The effect of this increase in the spawning component on future recruitment is unknown and could not be taken in consideration in this projection.

References

SHEPHERD, J. G. 1999. Extended survivors analysis: An improved method for the analysis of catch-at-age data and abundance indices. *ICES J. Mar. Sci*., **56**(5): 584-591 (October 1999).

DARBY, C. D., and J. C. MAHE. 2000. An analysis of stock status of the Greenland Halibut in Subarea 2 and Divisions 3KLMNO based on Extended Survivors Analysis. *NAFO SCR Doc*., No. 53, Serial No. N4286, 25 p.

Table 1. Greenland halibut in NAFO Subarea 2 and Div. 3KLMNO - Input parameters for the short- and medium-term predictions and risk analysis.

Input data

Age	N	CWt	SWt	M	PR
1	154560	0.030	0.000	0.2	0.000
2	129140	0.145	0.000	0.2	0.000
3	115557	0.176	0.000	0.2	0.000
4	112099*	0.253	0.000	0.2	0.001
5	133863*	0.358	0.358	0.2	0.017
6	106199*	0.533	0.533	0.2	0.067
7	86739	0.825	0.825	0.2	0.206
8	30383	1.253	1.253	0.2	0.246
9	14766	1.675	1.675	0.2	0.244
10	6139	2.287	2.287	0.2	0.214
11	1813	2.888	2.888	0.2	0.243
12	853	3.509	3.509	0.2	0.239
13	623	4.456	4.456	0.2	0.207
14	651	5.789	5.789	0.2	0.207

CVs

Source	VPA	Aver. 96-99	Aver. 96-99	Assumed	Average PR(97-99)
Error model	lognormal	normal	normal	normal	normal
Age					
1	0.79	0.000	0.000	0.15	0.000
2	0.79	0.504	0.504	0.15	0.000
3	0.47	0.186	0.186	0.15	0.000
4	0.27	0.083	0.083	0.15	0.201
5	0.2	0.043	0.043	0.15	0.303
6	0.17	0.045	0.045	0.15	0.142
7	0.16	0.029	0.029	0.15	0.191
8	0.15	0.032	0.032	0.15	0.156
9	0.14	0.020	0.020	0.15	0.137
10	0.15	0.015	0.015	0.15	0.226
11	0.19	0.030	0.030	0.15	0.218
12	0.2	0.058	0.058	0.15	0.407
13	0.21	0.064	0.064	0.15	0.483
14	0.25	0.036	0.036	0.15	0.483

Source N = From XSA output except *

N* = 0.5NXSA+0.5NGM(75-97)

PR = F 97-99 scaled to F99, CV from average PR 97-99 scaled to 1

R= GM(75-97)

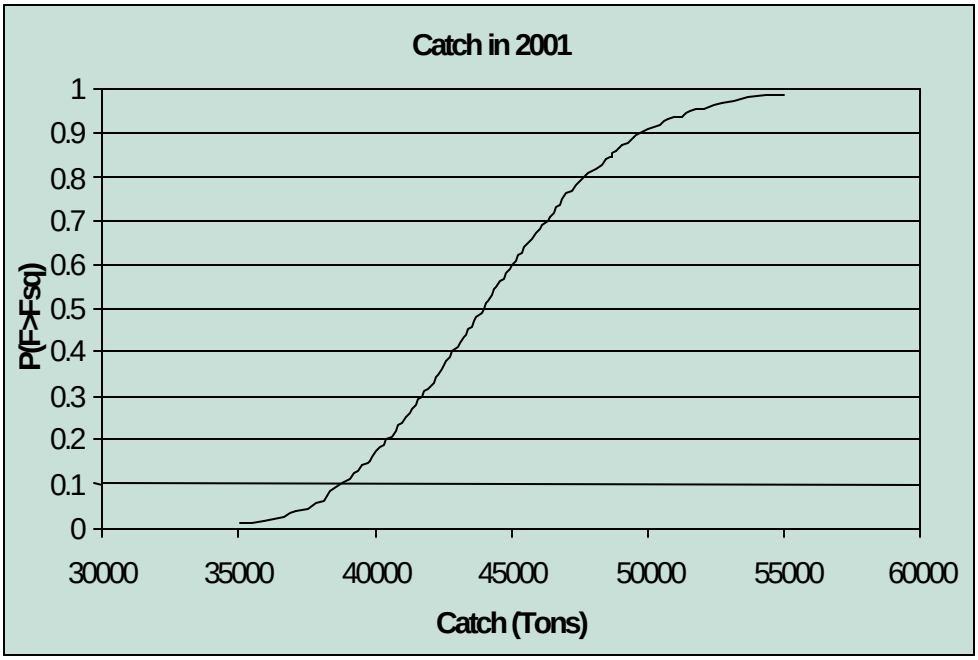

Fig. 1. Greenland halibut in NAFO Subarea 2 and Div. 3KLMNO – Probability profile of the *statu quo* catch prediction for 2001.

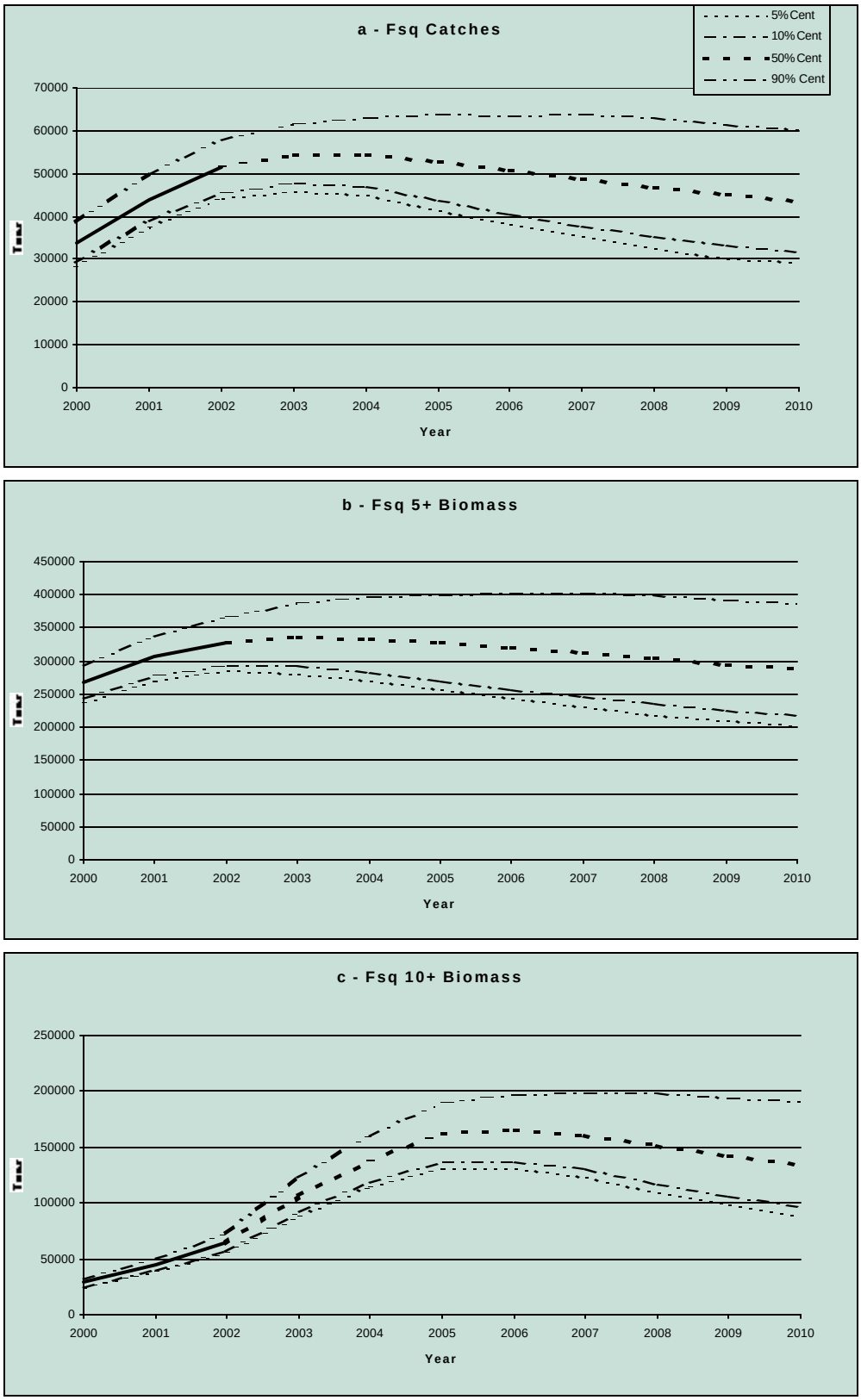

Fig. 2. Greenland halibut in NAFO Subarea 2 and Div. 3KLMNO – Medium term *statu quo* projections.